

iGEM 2016 Shad Valley – Day 3:

Synthetic Biology and Society

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Hello again everyone!

I hope you've been enjoying your time with us so far in the lab, and I hope you're all excited to see your transformed cells as well!

But before we get into your last day of experiments, we are going to talk about some cool applications of synthetic biology and its impact on society.

Before we begin, time for a quick primer on the CRISPR/Cas 9 System:

Possible applications of the CRISPR/Cas system that are currently being researched or that could be looked into down the road:

- Creation of transgenic animals with targeted mutations
- Drug development
- Agriculture
- Treating human genetic diseases

Imagine you're on the 2015 iGEM team...

- Imagine you guys are all members of the iGEM 2015 team. Team CRISPIER Plants was focusing their project on genetically modified plants using the CRISPR/Cas system.
- As members of the team, there are many factors that you would need to consider in terms of experimental design, lab work, and mathematical modelling to make the overall project a success.
- However, as I'm sure you're all aware by now, good science is not all about tossing on a lab coat, following a protocol and getting results to publish in a paper. There's plenty more than needs to be assessed.
- One essential sub-team of every iGEM team is Policy & Practices. These individuals are responsible for analyzing the feasibility of a project, including the ethics associated with it and its impact on society.
- Policy & Practices takes on many forms outside of iGEM including committee review boards, ethical committees, and team managers who are responsible for directing technical teams towards their goals.
- In general, scientists and engineers are faced with many responsibilities in their careers: towards their co-workers, their employers, and most paramount, the public at-large.
- At this point, what I'd like us to do is have an interactive discussion period. One experience that you all will have in university is working on and discussing topics in a group setting. And especially for ethics, a lot of these subjects may contain sensitive and sometimes even polarizing material. But its important for you guys to develop the skills of talking about some

of these things constructively while working toward a solution. That is, respect your neighbors' opinion even if you disagree with it. As my project manager always says: "Our team, our project".

Historically, how have societies overcome controversies about new, rapidly developing technologies?

- If the students seem stuck, make the following suggestions:
- Nuclear power; people were scared about it after the events of WWII and the Chernobyl incident
- Even though it's a bit of an older technology: electricity. Talk about the war of the currents between DC (Edison) and AC (Tesla)
- A new and current example: vaccines and anti-vaccers

Do synthetic biologists who are modifying organisms that are meant for human consumption have a larger responsibility for their research than most scientists? Why or why not?

- If students seem stuck, point out different types of people that would also share the responsibility of this research:
- Those involved in waste management and the disposal of these genetically modified food
- Those involved in food labelling and those who set standards for what is sold and regulated in grocery stores nationwide
- Those involved in education have the obligation to teach facts and not myths about GMOs

What are the benefits of genetically modified organisms (GMOs)?

On the topic of food, give the students hints (if necessary), such as:

- Longer shelf life of foods
- Resistant to viruses, infectious diseases, pests, etc.
- Higher in nutritional value
- Easier to grow as crops/produce
- Easier to be processed by the human digestion system

What are the potential negative effects of GMOs?

If students seem unsure, mention the following:

- Oversights on harmful long-term effects that may not be observed from preliminary short-term studies on the particular GMO.
- Here's a tricky point of discussion: Should genetic modification stop at plant cells? What if we were to conduct work on human cells?

- If there is no more discussion with this last question, bridge the conversation into human modification. It's a lot more of a sensitive topic, but students may benefit from this experience of discussing a gray area like this.

And now it's time to check out your colonies! Thank you very much for listening to my presentations 😊

At this point, students can be adjourned from the presentation and can go check their cells if the presentation hour is fully over.

Otherwise, students can complete another activity such as a pre-prepared Jeopardy game or something like that.